The Physical Environment in Coastal Upwelling Regions

(Introduction)

JAMES J. O'BRIEN

The Florida State University, Tallahassee, Florida 32306, U.S.A.

This is an introduction to a series of papers on the physical aspects of coastal upwelling in several of the well-studied locations of the phenomenon in the world. Coastal upwelling is a process whereby cold nutrient-rich subsurface water is brought to the ocean surface. Vertical speeds are of the order 0.01 to 0.001 cm s$^{-1}$. The vertical motion is caused by local and remote winds and the effect of the earth's rotation. Equatorward winds along the east side of the ocean cause offshore currents; these produce an Ekman divergence on the continental shelf and produce the vertical motion.

In the 1970's the oceanographers convinced their governments to invest over 30 million dollars in coastal upwelling research in the physical, biological and chemical disciplines. It is generally recognized that great progress has been made in understanding coastal upwelling. The physical oceanographers have, perhaps, made the greatest progress. For several years, attempts have been made to convince the participating scientists to prepare review papers on the new understanding. Dr. WARREN WOOSTER, University of Washington, devoted several years to this project. This set of papers started to be written under his leadership.

Included in this collection are reviews of our knowledge of coastal upwelling off California, Peru, Northwest Africa, Southwest Africa and Somalia. The Paper by Brink is not specific to one region and describes our understanding of the near surface ocean circulation during active upwelling.

What is not included? Upwelling can occur off any coast or at the edge of the marginal ice edge when an offshore Ekman-like flow exists or Ekman suction is created by the wind. Upwelling will occur near any coast if the wind is in the correct direction and sustaining for a few days. There are many upwelling locations that have not been studied. There are also strong western boundary currents along many shores which mask the coastal upwelling circulation.

Also not included is a paper on the theoretical aspects of coastal upwelling. A good review in this area is needed. A review of equatorial upwelling is not included. Along the equator in the Atlantic and Pacific oceans, considerable upwelling occurs. It is expected that recent expeditions since 1979 have gathered sufficient new data to advance our knowledge of equatorial upwelling and a good review paper will be forthcoming in the near future.